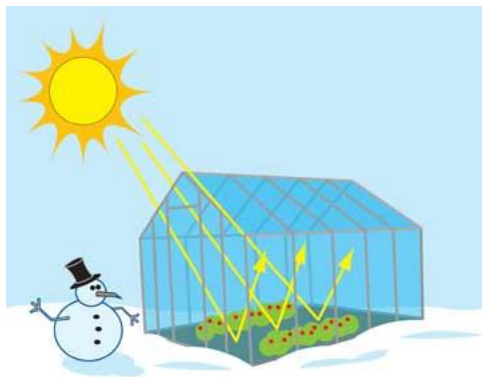


What is the Greenhouse Effect?¹



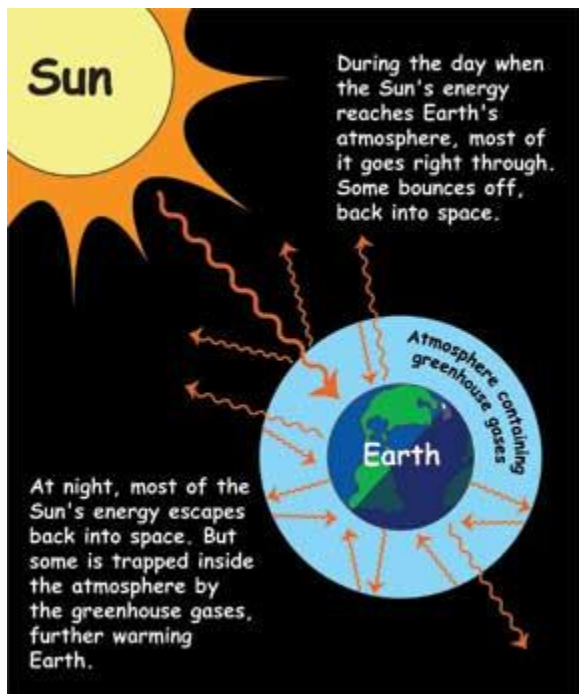
What is a greenhouse?

A greenhouse is made of glass. It traps the Sun's energy inside and keeps the plants warm, even in winter.

A greenhouse is a house made of glass. It has glass walls and a glass roof. People grow tomatoes and flowers and other plants in them. A greenhouse stays warm inside, even during winter. Sunlight shines in and warms the plants and air inside. But the heat is trapped by the glass and can't escape. So during the daylight hours, it gets warmer and warmer inside a greenhouse, and stays pretty warm at night too.

How is Earth a greenhouse?

Earth's atmosphere does the same thing as the greenhouse. Gases in the atmosphere such as carbon dioxide do what the roof of a greenhouse does. During the day, the Sun shines through the atmosphere. Earth's surface warms up in the sunlight. At night, Earth's surface cools, releasing the heat back into the air. But some of the heat is trapped by the greenhouse gases in the atmosphere. That's what keeps our Earth a warm and cozy 59 degrees Fahrenheit, on average.



Greenhouse effect of Earth's atmosphere keeps some of the Sun's energy from escaping back into space at night.

Is it warm in here, or is it just me?

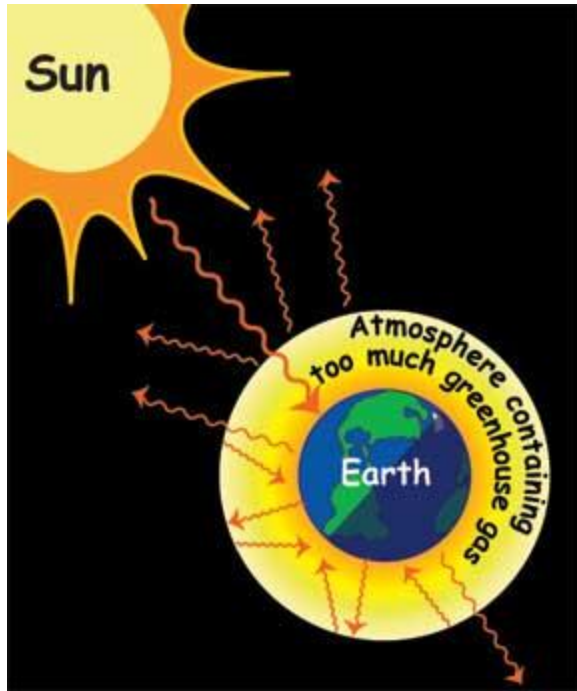
You might think 59 degrees Fahrenheit is pretty cold. Or, you might think that's warm. It depends on what you are used to. That temperature would melt all the Arctic ice. Yes, it's colder than 59 degrees in a lot of places, and hotter than 59 degrees in a lot of places, but 59 degrees Fahrenheit is the average of all of the places.



¹ <http://climatekids.nasa.gov/review/greenhouse-effect/>

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If the atmosphere causes too much greenhouse effect, Earth just gets warmer and warmer.

The point is, if the greenhouse effect is too strong, Earth gets warmer and warmer. This is what is happening now. Too much carbon dioxide and other greenhouse gases in the air are making the greenhouse effect stronger.

Why can't we just plant more trees?



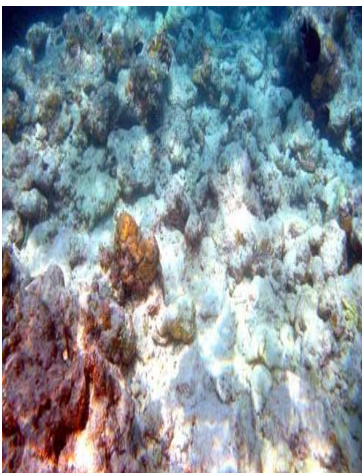
You might well wonder, because, after all, trees—like all plants—take in carbon dioxide and give off oxygen during photosynthesis.

Well, that might help a little. But, instead of planting more forests, some people are cutting them down and burning them to make more farm land to feed the growing human population. Combustion and respiration give off CO₂.



A forest burns. (Photograph copyright Woods Hole Research Center).

Why can't the oceans just absorb more Carbon Dioxide?

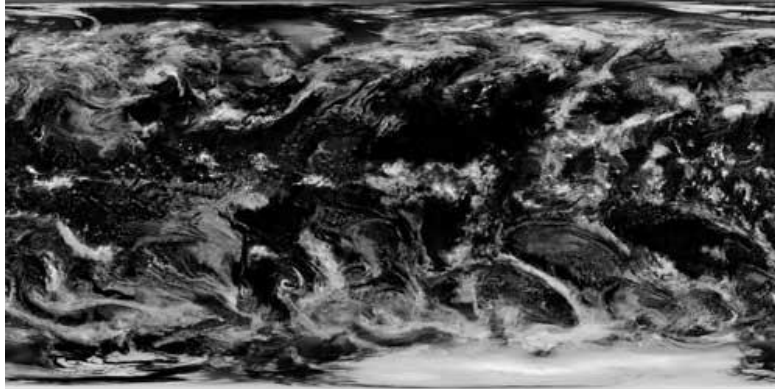


These coral are sick. They should be colorful, not bleached out.

The ocean also absorbs a lot, but not all, of the excess carbon dioxide in the air. Unfortunately, the increased carbon dioxide in the ocean changes the water, making it more acidic. Ocean creatures don't like acidic water. The bleached out, unhealthy coral in this picture is just one example of what acidic water can do. Another thing acidic water does is make shells of marine animals thinner because the acids dissolve the shells which make it harder for these shell organisms to survive.

Don't clouds keep Earth cooler?

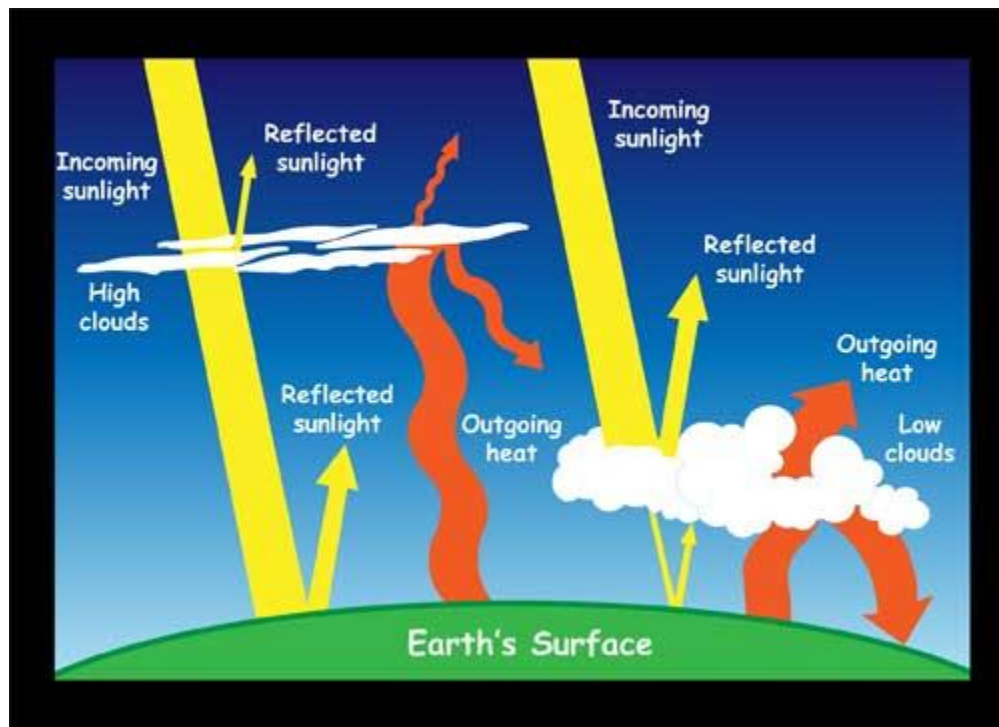
Water in the atmosphere also acts as a greenhouse gas. The atmosphere contains a lot of water. This water can be in the form of a gas—water vapor—or in the form of a liquid—clouds. Clouds are water vapor that has cooled and condensed back into tiny droplets of liquid water.



Earth's clouds as seen from space.

Water in the clouds holds in some of the heat from Earth's surface. But the bright white tops of clouds also reflect some of the sunlight back to space. So with clouds, some energy from the Sun never even reaches Earth's surface. Albedo effect is what reflection from white color is called.

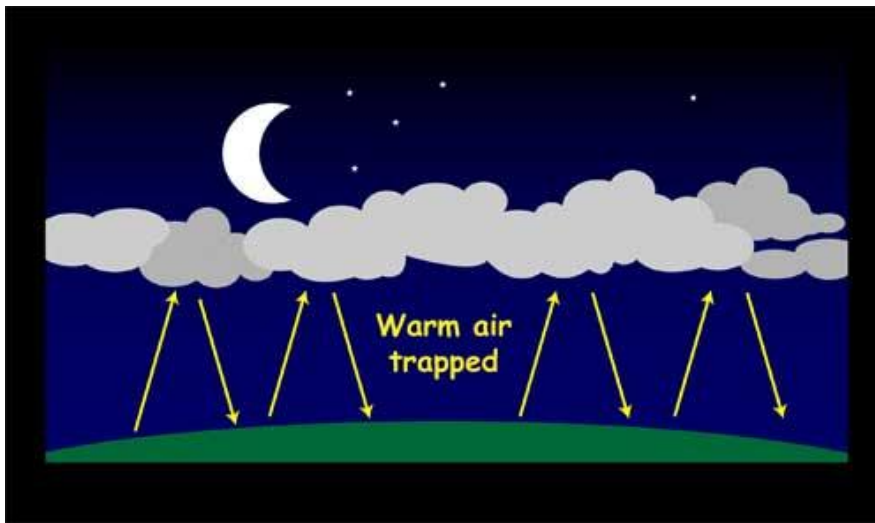
How much the clouds affect the warming or cooling of Earth's surface is one of those tricky questions that several NASA missions are aiming to answer.



Clouds prevent some of the Sun's energy from ever reaching Earth's surface.

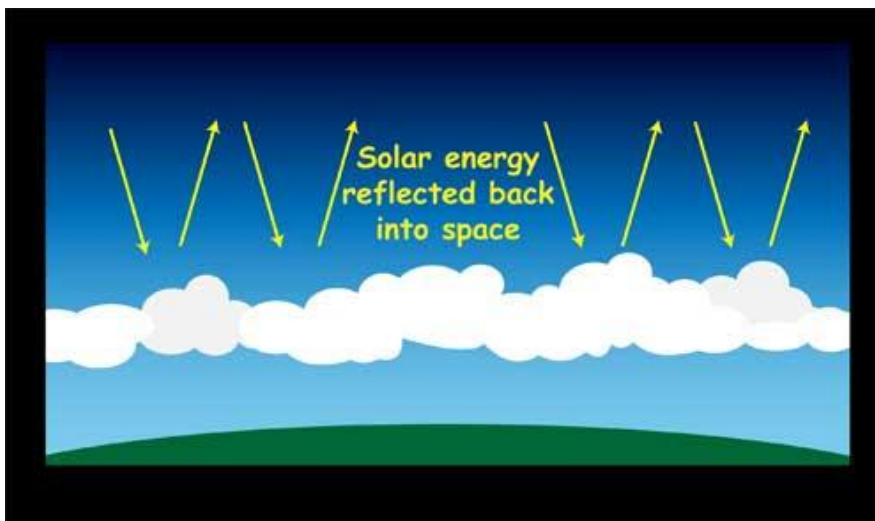
Or do clouds make Earth warmer?

Here is a riddle—a serious one, not a joke: As the ocean warms up, more water evaporates into the air. So does more water vapor then mean more warming? And does more warming mean more water vapor? And 'round and 'round we go?



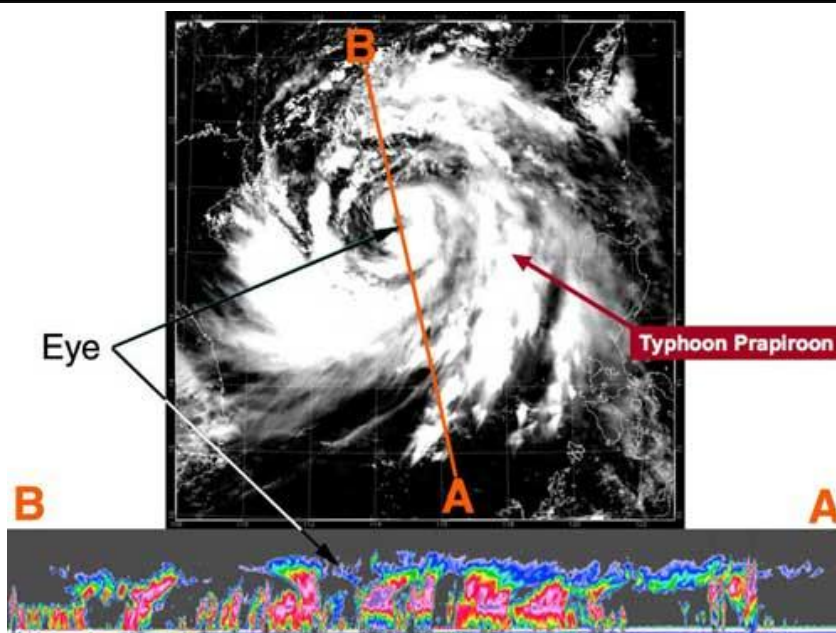
At night, clouds trap some of the heat from Earth's surface. Thus, it does not escape back into space.

Or, since more water vapor means more clouds, will the fluffy white clouds reflect enough sunlight back into space to make up for the warming?



During the day, clouds reflect the Sun's energy back to space, before it has a chance to heat Earth's surface.

This cloud riddle has scientists scratching their heads and trying to figure it out. NASA is helping with satellites like Aqua and CloudSat, which study the Earth's water cycle and clouds in 3-D.



The top image is a hurricane, as seen by a satellite. Below is a cross-section of the storm clouds. This colorful image was made with data from the CloudSat satellite. It shows with different colors how much water is contained in the clouds at different heights.